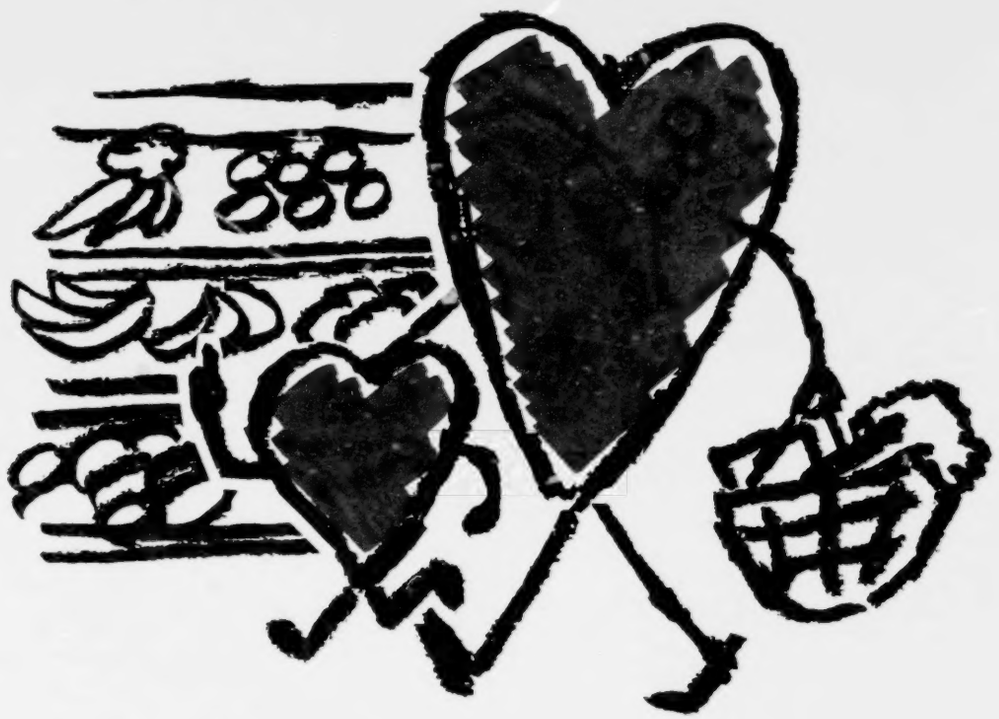
C 45/19/exec. sum

National Cholesterol Education Program

Report of the Expert Panel on

Population Strategies for Blood Cholesterol Reduction

Executive Summary



U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service • National Institutes of Health

HE 20.3202:

best copy available

National Cholesterol Education Program

Report of the Expert Panel on

Population Strategies for Blood Cholesterol Reduction

Executive Summary

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service • National Institutes of Health • National Heart, Lung, and Blood Institute

National Cholesterol Education Program

NIH Publication No. 90-3047

November 1990

Dedication To

JOSEPH STOKES III, M.D.

Dr. Joseph Stokes was a member of this panel until his untimely death in June 1989. It was his characteristically clear-sighted vision of the need for population strategies to lower blood cholesterol that led to the formation of the panel, and his contributions to the formulation and execution of the panel's work were extraordinary. Dr. Stokes played a pivotal role in shaping the development of the National Cholesterol Education Program (NCEP) as a leading member of the program's Coordinating Committee. His insight, scholarship, and commitment to public health were vitally important in ensuring the early success of the NCEP. Dr. Stokes' leadership and effective advocacy on behalf of the NCEP mirrored his dedication and monumental contributions to the prevention of cardiovascular disease in the United States. We dedicate this report to the memory of Dr. Joseph Stokes with respect and affection.

National Cholesterol Education Program

Expert Panel On Population Strategies For Blood Cholesterol Reduction

Richard A. Carleton, M.D., Chairman of the Panel

Johanna Dwyer, D.Sc., R.D.

Laurence Finberg, M.D.

June A. Flora, Ph.D.

DeWitt S. Goodman, M.D.

Scott M. Grundy, M.D., Ph.D.

Stephen Havas, M.D., M.P.H., M.S.

Gertrude T. Hunter, M.D.

David Kritchevsky, Ph.D.

Ronald M. Lauer, M.D.

Russell V. Luepker, M.D.

Amelie G. Ramirez, M.P.H.

Linda Van Horn, Ph.D., R.D.

William B. Stason, M.D.

Joseph Stokes III, M.D.*

Ex-Officio Members

James I. Cleeman, M.D., Executive Director of the Panel

Nancy Ernst, M.S., R.D.

William T. Friedewald, M.D.

Basil Rifkind, M.D.

Consultant

Karen A. Donato, M.S., R.D.

Staff

Marguerite A. Evans, M.S., R.D.

Laurie A. Quint-Adler, M.P.H., R.D.

* Deceased

Table of Contents

	Page
I. OVERVIEW AND SUMMARY	1
II. BACKGROUND AND INTRODUCTION	5
A. Coronary Heart Disease	5
B. Rationale for Both a Population Approach and a High-Risk Approach to Blood Cholesterol	7
C. Guidelines From Other Authoritative Sources	9
1. International	9
2. United States	12
III. CONCLUSIONS OF THE POPULATION PANEL	15
IV. RECOMMENDATIONS	17
A. Nutrient Intake	17
1. Rationale for Nutrient Intake Recommendations	18
B. Eating Patterns	20
C. Healthy Children and Adolescents	24
D. Special Groups	24
E. Health Professionals	25
F. The Food Industry	26
G. Mass Media	27
H. Government	27
I. Educational Systems	28
J. Measurement of Blood Cholesterol	29
K. Research and Surveillance	30
V. GLOSSARY	33
VI. BIBLIOGRAPHY	35

List of Figures

		Page
1.	Relationship Between Serum Cholesterol Level and CHD Death Rate (MRFIT Screenees)	7
2-5.	Cholesterol Distribution in the U.S. Population (Males/Females Combined, Ages 20-74, NHANES II 1976-80), and Potential Changes in the Distribution	10-11

List of Tables

1.	Recommendations of the Adult Treatment Panel of the National Cholesterol Education Program for Classification of Patients	8
2.	CHD Risk Factors Other Than LDL-Cholesterol	9
3.	Dietary Recommendations Related to Blood Cholesterol Levels by United States Organizations Since 1983	13
4.	Guidelines for Referral of People Based on Their Blood Cholesterol Level	30

I. Overview and Summary

Coronary heart disease (CHD) is a major public health problem in the United States. Despite substantial success in reducing premature deaths from CHD in the past two decades, this disease continues to kill more than 500,000 Americans annually. About 1,250,000 Americans suffer myocardial infarctions each year, and millions more have angina pectoris. In addition, significant degrees of asymptomatic CHD are very common in our population. In addition to its impact on the Nation's health, CHD costs the U.S. economy over $50 billion annually.

Coronary heart disease is the result of atherosclerosis, in which deposits of cholesterol and other lipids, along with cellular reactions, thicken artery walls. This process gradually reduces the caliber of the artery and restricts blood flow. Inadequate blood flow may cause injury to or death of tissue beyond the site of reduced flow; in the coronary arteries, this leads to myocardial infarction or sudden death.

Many factors influence not only whether a person will develop CHD but also how rapidly atherosclerosis progresses. Genetic predisposition, gender, and advancing age are recognized factors over which we have little control. High blood cholesterol, cigarette smoking, high blood pressure, excessive body weight, and long-term physical inactivity are also key risk factors over which we have considerable control. Control of each of these factors is important in the prevention of CHD. People with diabetes may also be able to avoid or delay vascular disease by controlling the other risk factors.

High blood cholesterol levels clearly play a causal role in CHD. This conclusion is based on experimental laboratory work, extensive clinical and pathological research, and numerous epidemiologic studies over the past several decades. The magnitude of the problem posed by elevated blood cholesterol levels is very clear. High CHD rates occur among people with high blood cholesterol levels of 240 mg/dL (6.21 mmol/L) or above. However, an even larger number of *cases* occurs in Americans with blood cholesterol levels below 240 mg/dL. It is important to note that the average cholesterol level for the adult U.S. population is about 210 mg/dL. Furthermore, approximately 55 percent of adult Americans have cholesterol levels at or above 200 mg/dL.

For these reasons, two kinds of strategies are needed: patient-based strategies, which seek to help those with the highest blood cholesterol levels, and population-based strategies, which seek to reach all Americans. The population approach aims both to lower the blood cholesterol level of individuals and to reduce the average cholesterol level throughout the population. When both approaches are used, the effects are synergistic.

Two important types of research provide ground for optimism that CHD morbidity can be reduced, and that the trend of reduced CHD death rates will continue or accelerate. First, studies consistently indicate that reducing blood cholesterol can reduce the likelihood of developing or dying from CHD. Dietary factors in individuals and in entire populations have important effects on blood cholesterol levels (although genetic makeup, expressed, in part, as a low level of HDL-cholesterol or as a high level of LDL-cholesterol, also plays a major role). Second, this report clearly indicates that many effective strategies exist for helping Americans develop more healthful eating patterns and lifestyles.

The Population Panel of the National Cholesterol Education Program offers a set of recommendations designed to help healthy Americans lower their blood cholesterol levels through

changes in eating patterns and thus reduce their likelihood of developing CHD. Recognizing that Americans' food consumption is influenced by many factors, the panel directs its recommendations to individuals, to special population groups, to health professionals, to the many components of the food industry, to relevant government agencies, and to public and private education systems. In addition, the panel's recommendations address cholesterol screening, and the need for continued research and evaluation as eating patterns change, blood cholesterol levels decrease, and CHD continues to decline.

The panel recommends the following nutrient intakes for healthy Americans:

- Less than 10 percent of total calories from saturated fatty acids.
- An average of 30 percent of total calories or less from all fat.
- Dietary energy levels needed to reach or maintain a desirable body weight.
- Less than 300 mg of cholesterol per day.

Each is intended to be achieved by an individual as an *average* of nutrient intake over several days.

These recommendations concerning nutrient intakes are appropriate for the general population, including healthy *women* and *individuals 65 years of age and older*.

As *healthy children* join in the eating patterns of others in the family, usually at about 2 years of age or older, they should follow the recommended nutrient intake and eating patterns.

To achieve more healthful eating patterns, the panel recommends that healthy Americans select, prepare, and consume foods that contain lower amounts of saturated fatty acids, total fat, and cholesterol; choose a variety of foods to ensure recommended intakes of carbohydrates, protein, and other nutrients; and consume only enough calories to maintain desirable weight.

The panel also makes recommendations for other groups:

Health professionals should both practice and advocate the recommended eating patterns; ensure that education of future health professionals includes appropriate nutrition education; and work with industry, government, voluntary groups, and health care agencies to facilitate adoption of the recommended eating patterns.

The food industry, food and animal scientists, and food technologists should increase efforts to design, modify, prepare, promote, label, and distribute good-tasting, safe foods that are lower in saturated fatty acids, total fat, and cholesterol.

Government agencies should provide consistent, coordinated nutrition statements and policies emphasizing low saturated fatty acid, low-fat, and low-cholesterol eating patterns; should expand and standardize food labeling requirements to identify clearly the content of saturated fatty acids, total fat, cholesterol, and total calories; and should take other steps to improve the consumer comprehension necessary to achieve the recommended eating patterns.

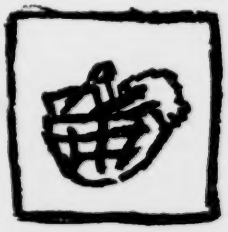
Educational programs at all levels should incorporate curricula that emphasize the background, benefits, and methods of achieving eating patterns that are lower in saturated fatty acids, total fat, and cholesterol. This recommendation includes elementary through high schools, vocational programs (especially in culinary arts), colleges, universities, and health professional schools.

Measurement of blood cholesterol, followed by appropriate education and counseling, is best initiated in the health care setting; but in specific circumstances and especially for selected segments of hard-to-reach population groups, public screening for blood cholesterol, when carried out with high quality standards, is appropriate.

Research and surveillance must be ongoing to develop new information concerning diet,

blood lipids, and CHD; the development of better data bases concerning food composition, food consumption patterns, illness rates, food product development, and nutrition education and communication is critical.

Implementation of these recommendations will promote adoption of eating patterns that will help most Americans lower their levels of blood cholesterol. The result, an approximate reduction of 10 percent or more in the average blood cholesterol level of the U.S. population, will lead to an approximate reduction of 20 percent or more in coronary heart disease and, in consequence, to significant improvement in the health and quality of life of Americans.



II. Background and Introduction

Cholesterol was identified many years ago as a prominent chemical component of the atherosclerotic lesion in human arteries. Following those early observations, a large base of scientific evidence has accumulated linking dietary saturated fatty acid (SFA) and cholesterol intake, blood cholesterol, atherosclerosis, and coronary heart disease (CHD). Animal, biochemical, genetic, metabolic, clinical, and epidemiologic research have all made important contributions to understanding these relationships. Clinical intervention trials have shown reduced CHD rates when cholesterol levels are reduced. While it is apparent that individuals with high blood cholesterol levels are at high risk of CHD, a larger number of individuals with more moderately elevated cholesterol also have increased risk of coronary events; such individuals comprise a substantial proportion of the adult U.S. population. From these observations, it follows that a two-pronged strategy is appropriate to address the high prevalence of CHD in Americans. The patient-based approach seeks to identify those at highest risk and to treat them to lower their blood cholesterol level. The population approach seeks to influence the population at large to alter current eating patterns, and thereby to lower individual and average population levels of blood cholesterol. These two approaches are complementary means of achieving lower rates of CHD and better health of the public. This report deals with the population approach.

In 1984, the National Institutes of Health (NIH) convened a Consensus Development Conference on Lowering Blood Cholesterol to Prevent Heart Disease. Among the recommendations from this conference were identification and treatment of individuals with high-risk cholesterol levels, changes in eating patterns for members of the general public, and the creation and implementation of a national cholesterol education program, which the National Heart, Lung, and Blood Institute (NHLBI) had begun to plan in early 1984. The National Cholesterol Education Program (NCEP) was launched in November 1985. The goal of the NCEP is to reduce the prevalence of elevated blood cholesterol in the United States, thereby contributing to the reduction of CHD morbidity and mortality. The NCEP is designed to reach and influence both health professionals and the public. This program provides an opportunity for individuals to assume an active role in reducing their risk of CHD. Under the direction of a multidisciplinary coordinating committee representing a variety of agencies and organizations, the program has accelerated the process of increasing public and professional awareness of the importance of reducing elevated blood cholesterol levels. The NCEP has issued reports developed by its Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel or ATP) and its Laboratory Standardization Panel (LSP). The present report has been developed by a third panel, the Population Panel, which has conducted an intensive review of the scientific basis for making blood cholesterol-lowering recommendations, especially eating pattern recommendations, to the general public. A fourth panel will report later on blood cholesterol reduction in children and adolescents.

A. Coronary Heart Disease

Atherosclerosis is a complex disorder, the development of which involves the interplay of many factors. Blood cells such as monocytes and platelets, the blood coagulation system, endothelial cell damage, and deranged function of arterial

wall macrophages and smooth muscle cells all contribute to the atherosclerotic process. Many other risk factors play important roles. The process involves the deposition of cholesterol in arterial walls and progresses with cellular proliferation, fibrous tissue deposition, and further cholesterol deposition, creating progressively larger atherosclerotic plaques. As atherosclerosis progresses, the opening in the artery through which blood flows is gradually reduced in size. The degree of arterial narrowing may be abruptly increased by thrombosis, by plaque disruption, or by smooth muscle spasm. Closure of an artery may cause injury and death of tissue beyond the site of blockage. When a coronary artery closes, myocardial infarction or sudden death is a common outcome.

Approximately 1,250,000 Americans each year suffer a myocardial infarction. More than 500,000 die annually from CHD. More than 6,000,000 Americans have symptomatic CHD, while it is estimated that nearly 70 percent of adult Americans have some degree of atherosclerotic narrowing of their coronary arteries. From a public health perspective, CHD is a major health problem. The economic costs have been estimated to be over $50 billion annually for illness care and lost earnings and productivity related to CHD.

Although the precise causes of atherosclerosis have not been identified fully, clinical, epidemiological, animal, and biochemical evidence demonstrate that many major factors contribute to the process. Three of these factors—gender, advancing age, and genetic composition—cannot be changed, but their effects can be mitigated.

Several other important risk factors for CHD are modifiable and provide opportunities for individuals and populations to reduce their likelihood of developing CHD. The most important are high blood cholesterol, high blood pressure, and cigarette smoking. Numerous epidemiologic studies show that the smoking habit increases the chances of developing CHD, as well as the probability of lung cancer or emphysema. The risk of both CHD and lung disease decreases with smoking cessation. High blood pressure accelerates the atherosclerotic process; control of high blood pressure reduces the likelihood of stroke and probably decreases the incidence of CHD.

Other risk factors have also been identified. Three are of particular note: overweight, diabetes mellitus, and a sedentary lifestyle. Maintaining or achieving a desirable weight is important both by itself (because excess weight is probably an independent risk factor for CHD) and because people who have a desirable body weight are less likely to have high blood cholesterol, a low high density lipoprotein (HDL) cholesterol level, or high blood pressure and are also less likely to develop diabetes mellitus than obese people. It may be possible to prevent many cases of non-insulin-dependent diabetes mellitus by avoiding obesity; furthermore, there is hope that control of the three major modifiable CHD risk factors will help diabetics avoid many vascular complications. Moderate, regular aerobic exercise throughout life is also important, in part because it enhances cardiovascular fitness and facilitates control of high blood pressure and excess body weight, and in part because of its generally favorable effect on HDL-cholesterol.

As has been reviewed extensively in section V of this report, entitled Scientific Evidence for Recommendations Affecting the General Public, consistent evidence from multiple avenues of research implicates high blood cholesterol in the causation of atherosclerosis and CHD. Both genetic and dietary factors influence blood cholesterol levels. Saturated fatty acids (SFA), cholesterol, and excessive calories in the diet tend to elevate the blood cholesterol level. There is now conclusive evidence that lowering elevated blood cholesterol decreases CHD risk; this has special importance for dietary recommendations.

The NCEP represents a major effort to reduce CHD rates in the United States by helping to lower elevated blood cholesterol levels, in part through favorable alterations in eating patterns. Together, the National High Blood Pressure Education Program, federally sponsored smoking education programs, and the NCEP are designed to reduce the three major modifiable risk factors for CHD and improve the health of the American public.

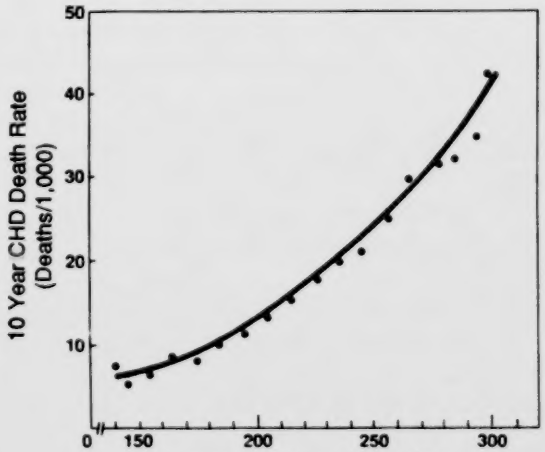
B. Rationale for Both a Population Approach and a High-Risk Approach to Blood Cholesterol

Epidemiological, clinical, and experimental evidence clearly demonstrate that the likelihood that a person will develop or die from CHD is directly related to the level of blood cholesterol. This relationship is well illustrated by the 10-year followup experience of men, initially ages 35 to 57 years, screened for the Multiple Risk Factor Intervention Trial (MRFIT).[1] As shown in figure 1, using data from MRFIT, the relationship is continuous and the risk increases with rising cholesterol levels. The risk of dying from CHD increases slowly between 150 mg/dL (3.88 mmol/L) and 200 mg/dL (5.17 mmol/L) and more rapidly when the cholesterol level exceeds about 200 mg/dL (5.17 mmol/L). For those individuals with cholesterol levels between 240 mg/dL (6.21 mmol/L) and 300 mg/dL (7.76 mmol/L), the likelihood of CHD is increased up to fourfold above that for those with levels below 200 mg/dL (5.17 mmol/L). Similar relationships between blood cholesterol and CHD have been found in many other studies.

In the United States, as in many other nations of the world, a majority of people have a blood cholesterol level high enough to increase significantly the likelihood of CHD. Thus, data from the National Health and Nutrition Examination Survey, known as NHANES II (1976-80) (figure 2, page 10), showed the mean cholesterol level for the adult U.S. population to be about 210-215 mg/dL (5.43-5.56 mmol/L).[2] Approximately 30 percent of adult Americans had cholesterol levels of 200-239 mg/dL (5.17-6.18 mmol/L), and more than 25 percent had levels of 240 mg/dL (6.21 mmol/L) and above. Figure 1 shows the high CHD death rate of those in this upper 25 percent of the cholesterol distribution. Despite the lower relative risk of the 75 percent of the population with blood cholesterol levels below 240 mg/dL (6.21 mmol/L), this group experiences about 60 percent of all CHD deaths, reflecting both the larger number of people at risk and the effects of mildly to moderately elevated cholesterol levels as well as the influence of other risk factors. The fact that risk of CHD is by no means restricted to those with high blood cholesterol levels supports the need for a combined population and high-risk approach to CHD prevention.

Based on the scientific evidence of increased CHD risk with elevated blood cholesterol, along with the evidence that risk can be reduced by lowering high blood cholesterol levels, the ATP of the NCEP issued a series of recommendations for a strategy of detecting and treating individuals with a high blood cholesterol level.[3] This panel, building on the work of the Consensus Development Conference on Lowering Blood Cholesterol to Prevent Heart Disease, classified blood cholesterol levels for adults. Levels under 200 mg/dL (5.17 mmol/L) are termed "desirable." Levels between 200 mg/dL and 239 mg/dL (5.17 and 6.18 mmol/L) have been classified "borderline-high," while levels of 240 mg/dL (6.21 mmol/L) and

Figure 1
Relationship Between Serum Cholesterol Level and CHD Death Rate (MRFIT Screenees)



From 361,662 Men Screened for MRFIT Program

above have been designated as "high." The ATP has presented a comprehensive set of recommendations for intervention in individuals with cholesterol levels above the desirable range. These recommendations emphasize that after initial screening for total cholesterol level, therapeutic decisions should be based on the level of low density lipoprotein (LDL) cholesterol (see table 1). Adult Americans with LDL-cholesterol levels that are persistently high-risk (or borderline-high-risk if definite CHD or two or more of the other major CHD risk factors listed in table 2 are present) should follow the recommendations of the ATP of the NCEP.

The ATP set forth detailed recommendations indicating that dietary therapy is the mainstay of treatment. Drug therapy should generally be considered only after 6 months of intensive dietary therapy reinforced by the help of a health professional with special nutrition expertise (e.g., a registered dietitian), and then only if the LDL-cholesterol level remains significantly elevated. This conservative approach to drug therapy is wise because drugs can not only bring benefits but can also have deleterious effects.

The potential impact of the recommendations of the ATP on the blood (serum) cholesterol distribution of the adult U.S. population is indicated conceptually by the broken line in figure 3, page 10. These recommendations of the ATP should, over the years to come, reduce the proportion of individuals in the United States with high cholesterol levels (240 mg/dL [6.21 mmol/L] and above), and should also reduce the proportion of individuals with borderline-high cholesterol levels (200-239 mg/dL [5.17-6.18 mmol/L]). Even in the event that the high-risk approach recommended by the ATP is largely effective, however, many people will remain at risk of CHD.

The recommendations from the Population Panel of the NCEP follow. They are intended to extend the benefits of cholesterol lowering to the population as a whole by promoting adoption of eating patterns that will help lower the blood cholesterol levels of most Americans. In turn, these eating patterns should help to shift the curve representing the population distribution of cholesterol to the left, as shown in figure 4, page 11. As the recommended eating patterns become widely adopted, the average blood cholesterol level should decrease by approximately 10 percent or greater.

Table 1

Recommendations of the Adult Treatment Panel of the National Cholesterol Education Program for Classification of Patients

Classification Based on Total Cholesterol	Classification Based on LDL-Cholesterol
<200 mg/dL (<5.17 mmol/L) Desirable Blood Cholesterol	<130 mg/dL (<3.36 mmol/L) Desirable LDL-Cholesterol
200-239 mg/dL (5.17-6.18 mmol/L) Borderline-High Blood Cholesterol	130-159 mg/dL (3.36-4.11 mmol/L) Borderline-High-Risk LDL-Cholesterol
≥240 mg/dL (≥6.21 mmol/L) High Blood Cholesterol	≥160 mg/dL (≥4.13 mmol/L) High-Risk LDL-Cholesterol

Source: NCEP ATP, January 1988.[3]

Table 2

CHD Risk Factors Other Than LDL-Cholesterol

- **Male sex**
- **Family history of premature CHD** (definite myocardial infarction or sudden death before age 55 in a parent or sibling)
- **Cigarette smoking**
- **Hypertension**
- **Low HDL-cholesterol concentration** (below 35 mg/dL confirmed by repeat measurement)
- **Diabetes mellitus**
- **History of definite cerebrovascular or occlusive peripheral vascular disease**
- **Severe obesity** (≥30% overweight)

Source: NCEP ATP, January 1988.[3]

The anticipated combined and compatible effects of the recommendations from the Adult Treatment Panel and from the Population Panel of the NCEP are estimated in figure 5, page 11. Most Americans would have a desirable blood cholesterol level. Far fewer Americans would require drug therapy for persistently high blood cholesterol. The anticipated effect would be to reduce the morbidity from CHD and to produce a continued or accelerated decline in the mortality rate from CHD in the United States.

C. Guidelines From Other Authoritative Sources

1. International

The work of many scientists has shown that atherosclerosis and CHD constitute a major health problem afflicting numerous nations of the world. The linkage of CHD to national eating patterns has been established. There is widespread international consensus, based upon repeated reviews of the scientific evidence, that the average population intakes of total fat, SFA, dietary cholesterol, and food energy are excessive in many countries and should be reduced. As a result, since 1973 more than 40 groups of scientists and health policy makers from other nations have recommended changes in population eating patterns with the purpose of reducing blood cholesterol. Most have focused on the prevention of CHD. These recommendations have been summarized by Truswell (1983),[4] and in the report of the National Research Council (NRC), *Diet and Health: Implications for Reducing Chronic Disease Risk*.[5] A World Health Organization (WHO) study group in 1989 proposed "population nutrient goals" to control noncommunicable diseases and suggested that these be introduced as part of nutrition policy in all countries.[6,7] These nutrient goals are remarkably similar to those of the NRC 1989 and NCEP 1990.

Cholesterol Distribution in the U.S. Population (Males/Females Combined, Ages 20-74, NHANES II 1976-80),[2] and Potential Changes in the Distribution

Figure 2

Population distribution of serum cholesterol values. The borderline-high and high cutoff levels are shown as dotted lines to indicate the proportions of the population above or below 200 or 240 mg/dL (5.17 or 6.21 mmol/L).

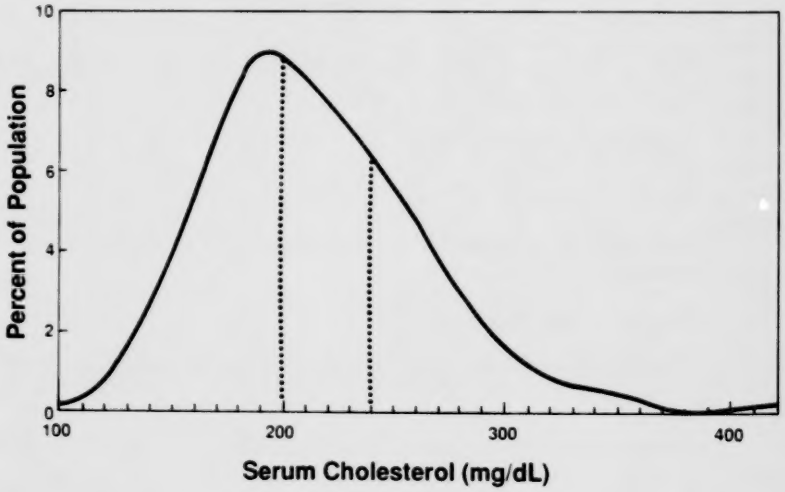
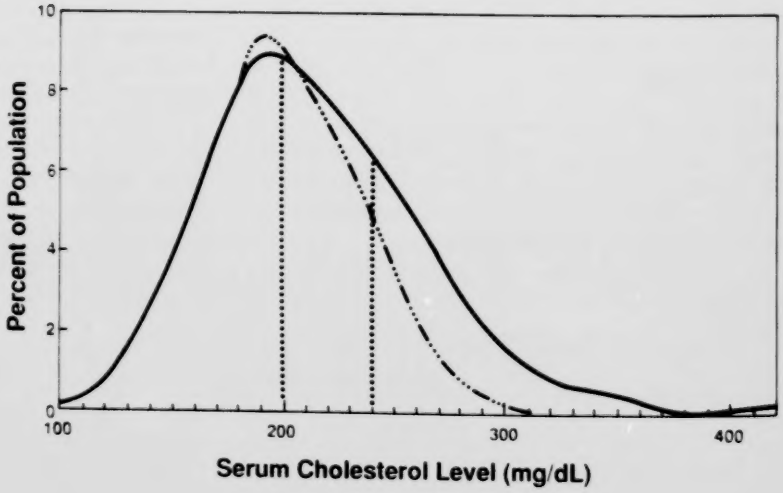


Figure 3

Expected shift in population distribution of serum cholesterol values with widespread application of ATP guidelines. The dotted-dashed line represents an estimate of the effect of treating many people with elevated cholesterol levels.



Cholesterol Distribution in the U.S. Population (Males/Females Combined, Ages 20-74, NHANES II 1976-80),[2] and Potential Changes in the Distribution

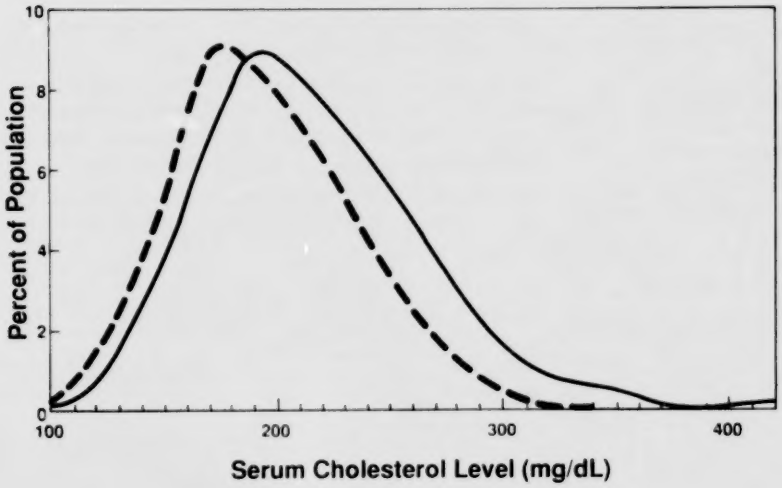


Figure 4

Expected shift in population distribution of serum cholesterol values if the recommendations of the Population Panel result in a 10% decrease in blood cholesterol of Americans. The dashed line shows the effect of the recommendations.

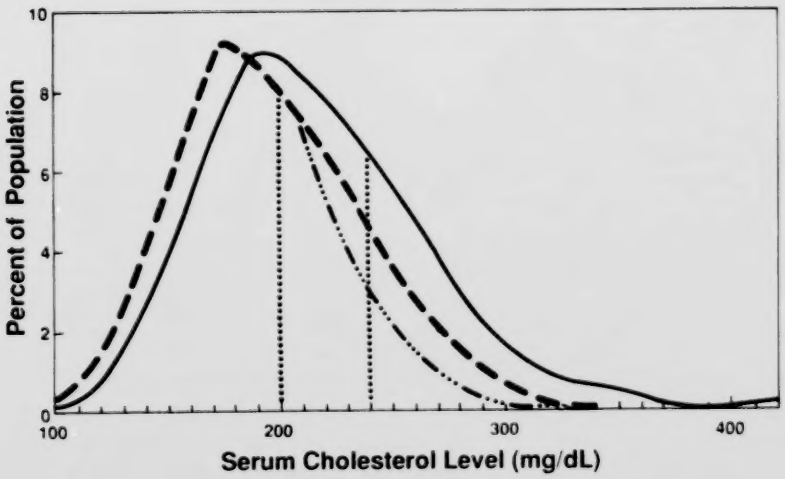


Figure 5

Anticipated combined effects of the recommendations of the ATP (dotted-dashed line) and the Population Panel (dashed line).

2. United States

Over the years, many reports linking CHD and diet have appeared in the United States. These have included several diet statements from the American Heart Association (AHA) issued between 1961 and 1988, the 1970 and 1984 reports of the Inter-Society Commission for Heart Disease Resources concerning primary prevention of atherosclerotic diseases,[8,9] the Bethesda Conference on Prevention of Coronary Heart Disease,[10] and the recent NRC report on diet and health.[5]

The dietary recommendations issued since 1983 by major health organizations in the United States are summarized in table 3. There are common themes—recommendations for a lower intake of SFA and total fat, a reduction in dietary cholesterol, an increased intake of complex carbohydrates, and the control of obesity. The advice given is similar from all these organizations, although some groups are more specific than others. Several recommend reductions of total fat intake to 30 percent or less of calories, of SFA to less than 10 percent of calories, and of dietary cholesterol to less than 300 mg per day.

Table 3

Dietary Recommendations Related to Blood Cholesterol Levels by United States Organizations Since 1983

Agency/Report	Year	Audience	Saturated Fat	Total Fat	Cholesterol	Carbohydrate	Body Weight
USDA/DHHS Dietary Guidelines for Americans	1985	Public	Avoid too much	Avoid too much	Avoid too much	Avoid too much sugar; Increase starch & fiber	Maintain desirable weight
NCEP-ATP Report of the Expert Panel on. . .High Blood Cholesterol in Adults	1987						
Step 1		Adult patients with high blood cholesterol	<10%	≤30%	<300mg/day	50-60%	Achieve & maintain desirable weight
Step 2			<7%	≤30%	<200mg/day	50-60%	
AHA Dietary Treatment of Hypercholesterolemia Steps 1 & 2 for patients identical to NCEP Steps 1 & 2	1988						
AHA Dietary Guidelines for Healthy American Adults	1988	Public	<10%	<30%	≤300 mg/day	50-55% with emphasis on complex carbs.	Maintain best body weight
AHA Diet in the Healthy Child	1983	Children	≤10%	Approx. 30%	≤300 mg/day	Approx. 55%	Caloric intake based on growth rate & activity level and to maintain desirable body weight
AAP Prudent Life-style for Children: Dietary Fat and Cholesterol	1986	Children	Decrease with moderation	30-40%	Decrease with moderation		Maintain ideal body weight
DHHS The Surgeon General's Report on Nutrition and Health*	1988	Public	Reduce	Reduce for most	Reduce	Increase complex carbs.; Limit sugars	Achieve & maintain desirable weight
NRC Designing Foods: Animal Product Options in the Marketplace**	1988	Public	≤10%	≤30%	≤300 mg/day		Achieve & maintain desirable weight
NRC Diet and Health: Implications for Reducing Chronic Disease Risk	1989	Public	<10%	≤30%	<300 mg/day	>55% with ≥6 servings grains & legumes/day, ≥5 servings fruits & vegetables per day	Balance food intake with physical activity to maintain body weight

* A review supporting USDA/DHHS (1985) recommendations.

** The report accepted these target levels from other authorities; it also made recommendations on marketing and policy issues and research imperatives.

III. Conclusions of the Population Panel

After carefully considering the extensive scientific evidence linking blood cholesterol, atherosclerosis, CHD, and diet, this panel concludes that excessive intakes of saturated fatty acids, total fat, and dietary cholesterol, together with excessive body weight, all contribute importantly to biologically unnecessary and undesirable elevations of blood cholesterol. The panel also reaffirms the conclusion of previous panels (AHA, ATP, NRC) that elevated levels of blood cholesterol produce a high prevalence of severe atherosclerosis in coronary arteries, resulting in a high incidence of CHD and premature death. Accordingly, the panel concludes that it is important for Americans to change their eating patterns to reduce the average intakes of saturated fatty acids, total fat, and dietary cholesterol, and to eliminate excess body weight.

The panel concludes that changing eating patterns will influence blood cholesterol levels and that eating patterns can be changed, while preserving the nutritional adequacy, variety, and affordability of good-tasting food. The panel regards reduction of dietary saturated fatty acid intake from both animal and vegetable sources as being of greatest importance. The work of the National Research Council[11] concerning the potential for reduction of fat in foods of animal origin indicates the feasibility of change in saturated fatty acid content of foods. Furthermore, the panel agrees that observance of the Dietary Guidelines for Americans issued by the U.S. Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS) can help promote health for individuals beyond the age of 2 years.[12] Although there are challenges to implementing some of the recommended changes, the panel believes that the potential benefits outweigh the expenditure of resources needed to achieve these changes. The panel believes that eating patterns of most Americans can change through a process of combining education for the public and actions by the many sectors of society that influence the availability, purchase, preparation, and consumption of foods.

The panel agrees with estimates that the health benefits to be expected for the average American, based upon available evidence, approximate a 2 percent reduction in CHD risk for each 1 percent reduction in blood cholesterol level.

It is from these perspectives that the Population Panel of the NCEP offers recommendations to help individuals in the United States lower their blood cholesterol levels.

IV. Recommendations

These recommendations are designed to encourage and assist each individual to adopt eating patterns to lower his or her blood cholesterol level and to reduce the number of people in the United States who develop or die from CHD. A blood cholesterol level under 200 mg/dL (5.17 mmol/L) is termed desirable for adults. To help Americans learn whether they have an elevated blood cholesterol level, this panel concurs with the ATP recommendation that all adult Americans should have their blood cholesterol level measured at least every 5 years. The average level of blood cholesterol in the U.S. adult population is approximately 210-215 mg/dL (5.43-5.56 mmol/L). It is anticipated that the recommended changes in eating patterns will result in a reduction of 10 percent or greater in the average person's blood cholesterol level and shift the population distribution curve for blood (serum) cholesterol values as shown in figure 4, page 11.

The nature of the food consumed by Americans is influenced by many factors. These recommendations are intended to provide guidance to many segments of the food production-consumption chain. Success will require adoption of these recommendations by all healthy Americans, health professionals, the food industry, educators at all levels, mass media, and many government agencies.

Accordingly, the panel makes the following recommendations for the *entire population of healthy Americans*. This population approach aims to promote healthful food choices and to make good-tasting food, lower in saturated fatty acids and cholesterol, more widely available to all Americans. Those whose blood cholesterol levels are higher than desirable can be expected to pay the most attention and to benefit the most from these recommendations. In addition, most individuals with desirable cholesterol levels can participate in the recommended eating patterns, and expect to lower CHD risk. The recommendations in this report are compatible with the Dietary Guidelines for Americans as set forth by the USDA and the DHHS.

A. Nutrient Intake

The panel concludes that health and nutrition professionals, the food industry, and the general public need specific guidance concerning intake of certain nutrients.

RECOMMENDATION A. 1: The panel recommends the following pattern of nutrient intake for all healthy Americans*:

- Less than 10 percent† of total calories from saturated fatty acids.
- An average of 30 percent of total calories or less from all fat.†
- Dietary energy (calorie) levels needed to reach or maintain a desirable body weight.
- Less than 300 mg of cholesterol per day.

* Concerning the very young, as healthy children join in the eating patterns of others in the family, usually at about 2 years of age or older, they should follow the recommended nutrient and eating patterns.

† Each gram of fat contains 9 Kilocalories (often called calories). A person consuming 1,500 calories daily should consume no more than 450 calories (1,500 calories x 0.30 = 450 calories) derived from all fat. At 9 calories per gram, less than 50 grams of fat (450 calories ÷ 9 calories/gram = 50 grams) should be consumed on the average day, and less than one-third or 17 grams of the 50 gram total should be from saturated fatty acids (1,500 calories x 0.10 = 150 calories; 150 calories ÷ 9 calories/gram = <17 grams).

Because food intake varies from day to day, these recommendations are meant to be achieved by each individual as an average of nutrient intake over several days.

The nutrient intakes recommended are critical to health-promoting eating patterns. They are essentially the same as those recommended by the American Heart Association, the National Research Council, and in the Step-One therapeutic diet of the ATP of the NCEP. The eating patterns that will be required in order to achieve these nutrient intakes by the public are to be attained gradually over time. Ultimately, changes in the food system will facilitate these changes in population-wide eating patterns. By contrast, the Step-One diet is intended to treat individuals who are at high risk of CHD because of substantially elevated blood cholesterol levels, through intensive nutritional counseling in a clinical setting, and with the intent of achieving a rapid and certain response. What makes the Step-One diet therapeutic for those at high risk is prescription in a medical setting along with the monitoring and followup offered by health professionals. The same eating pattern is suitable for adoption by the population at large in order to achieve a population-wide reduction of blood cholesterol. It is the intent of the recommendations of the Population Panel to foster healthful eating for Americans, young and old.

1. Rationale for Nutrient Intake Recommendations

This recommended pattern of nutrient intake is intended for healthy individuals. Strong scientific evidence indicates that attainment of each of the four recommendations will help most individuals lower their blood cholesterol and, in turn, reduce their probability of developing CHD.

The specific nutrient intake recommendations are based on the scientific evidence, but the exact numerical values reflect both science and pragmatism. Thus, there is virtually unanimous agreement that SFA intake should be reduced. Most agree that the science base makes less than 10 percent of calories from SFA an appropriate level, although there is no precise guidance as to which level under 10 percent is best. For the sake of practicality, consistency, and comprehensibility, the phrase "less than 10 percent" has been chosen. A similar process led to recommendations for total fat and cholesterol intakes. The available knowledge concerning the mechanisms through which these nutrients affect blood cholesterol is summarized in section V, Scientific Evidence for Recommendations Affecting the General Public.

The panel's rationale for each of the recommended nutrient intakes follows.

a. Fat Intake

Most of the U.S. population should reduce total dietary fat intake—by an amount that varies according to how much fat is currently consumed—to help achieve and maintain desirable body weight and to reduce the risk of certain diseases, particularly CHD. (See table 3, page 13, for a summary of recommendations from other authoritative groups.) Different kinds of fatty acids have different effects on blood cholesterol levels. In general, SFA raise blood cholesterol levels. Polyunsaturated fatty acids (PUFA) of the omega-6 series lower blood cholesterol levels, as do monounsaturated fatty acids (MUFA) and omega-3 PUFA, when substituted for SFA.

Total Fat. The panel recommends a target for individuals of an average of 30 percent of total calories or less from total fat. The percentage of calories from total fat intake, independent of the relative content of the different types of fatty acids, does not determine the level of blood cholesterol or CHD risk. As stated in the NRC report on *Diet and Health: Implications for Reducing Chronic Disease Risk*, "Fat intake should be reduced by curtailing the major sources of dietary fats rather than by eliminating whole categories of foods."[5] It is not necessary to resort to very low fat diets (e.g., 10-20 percent of total calories) to achieve a maximal reduction of blood cholesterol levels through dietary means, provided that intakes of saturated fatty acids are kept low. Therefore, the

panel accepts a target for individuals of an average of 30 percent or less of calories from fat. The panel does not recommend severe reduction of total fat intake; however, a limit to total fat intake is a rational part of a program aimed at reducing the risk for CHD because such a limit facilitates reduction of saturated fatty acid intake, and facilitates maintenance of desirable body weight. There is also evidence that suggests that a diet lower in fat may prevent certain types of cancer.[5,13]

Survey data indicate that for children ages 1 to 5 years, the average proportion of calories derived from fat was 34 percent; for women ages 19 to 50 years, 37 percent; and for men ages 19 to 50, 36 percent.[14-17] Thus, to achieve an average intake of 30 percent of calories or less from fat, reductions in calories from fat of at least 4-7 percent of total calories will be required, on average, for most Americans. For many individuals with fat intakes that are higher than average, however, an even greater reduction in fat intake will be necessary.

Saturated Fatty Acids. The major decrease in total fat should be in calories from SFA. Data from the USDA[14-17] indicate that SFA, as a proportion of calories, average about 13.2 percent in the diets of adults ages 19 to 50 years and 13.9 percent in those of children ages 1 to 5 years. Thus, the average reduction in the percentage of calories from SFA that is required to achieve the recommended nutrient intake is at least 3-4 percent. Individuals currently deriving higher percentages of calories from SFA will need to make greater reductions.

The greater the decrease in SFA intake, the greater will be the decline in blood cholesterol levels. Therefore, the reduction in saturated fatty acids in the diet should be as great as possible, consistent with palatability and practicality. This panel recommends a target of less than 10 percent of calories from SFA as both practical and palatable for Americans.

Other fatty acids. The remaining fatty acids, up to 20 percent of total calories, should come from unsaturated fatty acids. PUFA can provide up to, but no more than, 10 percent of total calories. The average intake of omega-6 PUFA in the American diet is about 7 percent of total calories,[5,14-17] which is an acceptable intake. Fish oil supplements generally do not reduce blood cholesterol levels. Omega-3 PUFA, however, reduce blood cholesterol when substituted for SFA. The other major type of unsaturated fatty acids, MUFA, should provide the remaining dietary fat. The current average intake of MUFA for the population is approximately 14-16 percent of calories. A slight reduction in average MUFA intake can be expected because foods of animal origin containing SFA often also have substantial amounts of MUFA.

Other Nutrients. Reducing fat intake will reduce energy intake unless other nutrients replace fat. Two other major macronutrients, protein and carbohydrates, as well as many micronutrients, are of importance. The panel recommends that the intake of carbohydrates be increased to 50-60 percent of total calories, primarily by increasing the intake of complex carbohydrates. This can be achieved by increasing the intake of vegetables and fruits, and of breads, legumes, and whole grain cereals. These plant products generally contain low levels of fat and are good sources of several vitamins, minerals, and dietary fiber. Protein intake should not be increased to compensate for the decrease in calories derived from fat. The recommended intake of protein is between 10 percent and 20 percent of calories. In general, average protein intake by adults in the United States considerably exceeds the recommended dietary allowance (RDA), which is 0.8 g/kg of desirable body weight for adults. Overall, the diet consumed should meet the RDA's for all other nutrients.

b. Body Weight

Body weight is influenced by many factors; energy balance between caloric intake and caloric expenditure largely dictates whether excess body fat accumulates. Many health problems are related to obesity. Obese people are more likely to have elevated blood cholesterol and triglyceride levels, a reduced level of HDL-cholesterol, high blood pressure, and adult-onset diabetes mellitus, and are more likely to develop CHD independently of these other factors. Loss of excess weight and maintenance of a desirable body weight is an important way of reducing blood cholesterol levels. The exact dietary energy (calorie) level needed to attain or maintain desirable body weight must be individually determined from observed changes in body weight.

c. Cholesterol Intake

Many studies have shown that dietary cholesterol raises the blood cholesterol level. It has been estimated that with a 2,500 calorie diet, for every 100 mg/day decrease in cholesterol intake, the blood cholesterol will decrease by about 4 mg/dL.[18] This response holds even at low intakes, and thus, the lower the cholesterol intake, the lower will be the blood cholesterol on the average. There appears to be considerable inter-individual variability in response of blood cholesterol to dietary cholesterol intake. Based on the observed effects of dietary cholesterol intake on blood cholesterol levels, the panel concludes, as have many investigators and expert panels, that high dietary cholesterol intake contributes to the development of atherosclerosis and increased CHD risk in the American population and should be reduced. Data from the USDA[14-17] indicated that the average daily intake of dietary cholesterol is 304 mg and 435 mg for women and men, respectively. The Population Panel recommends an intake of less than 300 mg of cholesterol per day.

B. Eating Patterns

The nutrient intakes recommended in this report are consistent with the Dietary Guidelines for Americans as set forth by the USDA and the DHHS.[12] These guidelines are suggested for most Americans. They do not apply to people who need special diets because of disease or conditions that interfere with normal nutrition. Such people may require special instruction from a health professional with expertise in nutritional counseling, such as a registered dietitian, in consultation with their own physicians. These USDA/DHHS guidelines[12] are:

- Eat a variety of foods;
- Maintain desirable weight;
- Avoid too much fat, saturated fatty acids, and cholesterol;
- Eat foods with adequate starch and fiber;
- Avoid too much sugar;
- Avoid too much sodium; and
- If you drink alcoholic beverages, do so in moderation.

The first two guidelines form the framework of a good diet—eating a variety of foods to ensure getting the essential nutrients, and eating only enough calories to maintain desirable weight. The next five guidelines describe special characteristics of a good diet—avoiding too much fat, saturated fatty acids, and cholesterol; getting adequate starch and fiber; and avoiding too much sugar, sodium, and alcohol.

This report focuses on the two guidelines that are particularly related to blood cholesterol and the prevention of CHD: Avoid too much fat, saturated fatty acids, and cholesterol; and maintain desirable weight.

The guidelines also set forth the principle that reductions in energy derived from fat should be offset by increased consumption of foods containing complex carbohydrates such as starch and fiber. The Population Panel recommends that between 50 percent and 60 percent of calories come from carbohydrates.

Several valuable documents have been developed to assist people to follow the Dietary Guidelines for Americans. These documents can also be used to follow the recommendations in this report. These include four new booklets to help consumers put the Dietary Guidelines into practice,[19] and *Dietary Guidelines and Your Diet*,[20] which includes "A Pattern for Daily Food Choices." The pattern suggests daily servings from the major food groups.[21] Valuable information is also contained in booklets and brochures available from the National Institutes of Health and the American Heart Association.

RECOMMENDATION B. 1: The panel recommends that healthy Americans, both adults and children, select, prepare, and consume foods that contain lower amounts of saturated fatty acids, total fat, and cholesterol.

The following specific practices can help Americans, both adults and children, lower blood cholesterol levels. These food choices and preparation methods form the framework of a good diet. Eating a variety of foods to get essential nutrients and only enough calories to maintain desirable weight is also important. These eating patterns are fully compatible with cultural and ethnic considerations and with personal preferences for good food.

- **Fruits, vegetables, whole grain products, legumes such as beans and peas.** These products contain complex carbohydrates, fiber, and minimal amounts of saturated fatty acids. Accordingly, it is recommended that healthy Americans:

  Eat a greater quantity and variety of fruits, vegetables, breads, cereals, and legumes. These choices will help to meet nutritional needs for minerals, vitamins, dietary fiber (including soluble fiber), and complex carbohydrates, and to replace calories from fat.

- **Low-fat dairy products**. Dairy products constitute a major source of fat and saturated fatty acids in the average American diet. For this reason, it is recommended that healthy Americans:

  Eat more low-fat dairy products such as skim or low-fat milk and skim or low-fat milk products. Choose them, in place of regular whole milk, cheese, cream, ice cream, butter, or other butterfat-rich products, to help meet nutritional needs for calcium, protein, and vitamin D (skim milk is an excellent source of calcium with minimal accompanying fat).

- **Low-fat meat, poultry, fish**. Red meats, both in surface fat and fat within the meat tissue, provide a substantial proportion of fat and saturated fatty acids for the average American. Choosing lean cuts of beef, pork, veal, or lamb, removing surface fat, and substituting fish or skinless poultry can significantly reduce saturated fatty acid intake. Thus, the panel recommends that healthy Americans:

  Eat moderate amounts (e.g., about 6 ounces per day, cooked) of trimmed, lean red meat, poultry without skin, or fish in place of choices high in saturated fatty acids. These choices will help meet nutritional needs for protein, iron, and zinc.

  Cholesterol is found only in products from animals.

  - Organ meats—liver, sweetbreads, kidneys, and brain—are very rich in cholesterol, and consumption should be limited.

- **Eggs**. Egg yolk serves as an important source of dietary cholesterol for most Americans. An average large egg yolk contains 213 mg of cholesterol. These facts lead the panel to recommend that healthy Americans:

Eat egg yolks only in moderation. Egg whites do not contain cholesterol and they can be eaten often.

- **Fats and oils**. All vegetable products are free of cholesterol. Many oils come from vegetable products. Most contain large proportions of monounsaturated and polyunsaturated fatty acids and small proportions of saturated fatty acids. Tropical oils such as palm kernel oil, coconut oil, and palm oil contain relatively large proportions of saturated fatty acids. Accordingly, the panel recommends that healthy Americans:

  Use oils, margarines, and shortenings with vegetable oils containing primarily unsaturated fatty acids instead of saturated fatty acids. Consumption of tropical oils, especially the most highly saturated palm kernel and coconut oils, should be minimized.

- **Baked goods**. Most commercially prepared baked goods contain ingredients composed of saturated oils or fats; many contain egg yolks. For these reasons, the panel recommends that healthy Americans:

  Choose prepared baked goods that have been made with unsaturated vegetable oils and, at most, small amounts of egg. Breads and most rolls are low in saturated fatty acids and cholesterol while other commercial products such as croissants, cakes, biscuits, doughnuts, and muffins are often high in saturated fatty acids.

- **Convenience Foods**. Increasingly, Americans are consuming meals, entrees, mixes, and other packaged foods that are conveniently reconstituted and/or reheated. While many of these products have constituents containing large proportions of saturated fatty acid, many do not. Accordingly, it is recommended that healthy Americans:

  Choose "convenience foods" guided by low saturated fatty acid, total fat, and cholesterol content as well as by cost considerations.

- **Food labels**. Increasingly, valuable information is presented on food labels concerning amounts and sources of saturated fatty acids, fat, cholesterol, and other nutrients. For this reason, the panel recommends that all healthy Americans:

  Know your food by reading food labels, including both ingredient and nutrition information. Choose more often foods with lower amounts or proportions of saturated fatty acids and/or fat and of cholesterol. Saturated fatty acids and cholesterol are often found together in foods. Saturated fatty acids are provided primarily by animal products such as the fat in meat, butter, whole milk, cream, cheese, and ice cream. These foods are also major sources of cholesterol.

- **Food preparation**. Preparation of food can significantly increase the proportion of calories from all fat and from saturated fatty acids. For this reason, it is recommended that healthy Americans:

  Keep use of fats to a minimum when preparing foods. Use the smallest amount possible of fat and fatty foods as ingredients. Cook foods in ways that minimize or eliminate fat content, such as broiling, boiling, steaming, microwaving, or baking, instead of frying in fats;

  Use smaller amounts of ingredients high in saturated fatty acids. Where fats are necessary, substitute fats high in unsaturated fatty acids for fats high in saturated fatty acids; substitute equal or smaller amounts of unsaturated margarine or oil for butter;

  Use low-fat alternatives in food preparation. For example, substitute 1%, skim, or reconstituted nonfat dry milk for whole milk or higher fat choices. Use low-fat yogurt, buttermilk, or evaporated skim milk in place of sour cream, cream, or cream cheese.

- **Eating out**. Americans, on average, derive a significant portion of their nutrition outside of the home. Thus, the panel recommends that healthy Americans:

In restaurants, select menu items that are low in saturated fatty acids, total fat, and cholesterol as well as cooked foods that are baked, boiled, or broiled without fat. Ask for lean cuts of meat trimmed of excess fat. Request that sauces and salad dressings be served in separate containers if high in fat and use them sparingly. Ask for information on ingredients and preparation of restaurant food. When eating out and on other social occasions, choose foods with less fat—e.g., larger amounts of vegetables, fruits, and grain products, and smaller amounts of foods that are likely to be high in saturated fatty acids.

- Fast foods.

  While increasing numbers of "fast food" outlets have choices in which low proportions of calories are derived from saturated fatty acids, many others contain large amounts of saturated fatty acids and cholesterol. For these reasons, the panel recommends that healthy Americans:

  Ask for information on the fat and saturated fatty acid content of "fast food" selections and choose foods that are nutritious and low in saturated fatty acids, total fat, and cholesterol.

- **Overly simple solutions**. An habitual pattern of eating that is consistently low in saturated fatty acids, total fat, and cholesterol is recommended. Focusing solely on the elimination of a single food such as egg yolks, however, is not necessary and will not, by itself, achieve sufficient blood cholesterol lowering. As indicated earlier, skim or low-fat dairy products and small portions of trimmed, lean red meat are desirable and nutritionally valuable. These foods and eggs in moderation can all be part of a blood cholesterol-lowering eating pattern. The panel therefore recommends that all healthy Americans:

  Recognize that no single food or supplement is the answer to achieving a desirable blood cholesterol level.

  - Fish oil supplementation will not lower b'ood cholesterol levels in most people. However, consumption of fish, a food low in saturated fatty acids, instead of foods that are higher in saturated fatty acids, is desirable.

  - Dietary fiber supplements are not a panacea for blood cholesterol problems. Foods rich in soluble dietary fiber are, however, a useful addition to a low saturated fatty acid, low-fat, and low-cholesterol eating pattern.

  - Alcohol is not recommended as a means of preventing CHD because it has not been shown to be effective and because of the potentially harmful effects of excessive alcohol intake.

RECOMMENDATION B. 2: The panel urges the public to recognize that an elevated blood cholesterol level is one of the important modifiable CHD risk factors together with smoking, high blood pressure, excess body weight, and physical inactivity.

The recommended eating patterns should be considered part of a personal health program which also emphasizes the following risk factors for coronary heart disease.

- **Smoking, high blood pressure.** Being a nonsmoker, and preventing and controlling high blood pressure are both important factors in prevention of CHD.

- **Excess body weight.** It is important for all healthy Americans to achieve and maintain desirable body weight by limiting energy (calorie) intake and by engaging in regular moderate exercise. Maintenance of desirable body weight is a useful means of controlling blood cholesterol.

- **Physical inactivity.** Apart from beneficial effects on body weight and on blood pressure, regular exercise throughout life is associated with a lower risk of CHD.

C. Healthy Children and Adolescents

RECOMMENDATION C. 1: The panel recommends that healthy children follow the recommended eating patterns that are lower in saturated fatty acids, total fat, and cholesterol as they begin to eat with the family, usually at 2 years of age or older.

The Population Panel has reviewed evidence concerning benefits and safety for children and adolescents of an eating pattern that is lower in saturated fatty acids, total fat, and cholesterol than the usual American diet. The panel also recognizes that the caloric and nutrient needs of children are critical for supporting growth and development. Since eating habits developed during childhood can influence lifetime practices, the panel urges prudent movement to the recommended eating pattern. Healthy children should be allowed to share in family food choices, recipes, and menus. Adolescents are particularly encouraged to maintain a low saturated fatty acid, low total fat, and low-cholesterol eating pattern.

Infants and children under the age of 2 years have dietary requirements different from those of older people. Infants whose diet is primarily mother's milk or formula often appropriately consume 40 percent or more of calories from fat. The Population Panel recommends that this well-established pattern of infant nutrition be encouraged. Care must be taken to ensure sufficient energy and nutrient intake to meet the needs of the growing child. A forthcoming report from the Expert Panel on Blood Cholesterol Levels in Children and Adolescents will deal with strategies for detection, evaluation, and treatment of children and adolescents at high risk of later CHD because of high blood cholesterol levels and will provide additional details about implementation of strategies for encouraging desirable eating patterns for healthy children.

D. Special Groups

RECOMMENDATION D. 1: The panel recommends that particular attention be paid to nutritional concerns of special segments of the population.

The eating patterns of specific groups of Americans should be considered. Population groups with special dietary concerns include women, older Americans, cultural and ethnic groups, low-income groups, and individuals with special nutritional needs.

- **Women**. Women, like men, can and should adopt the recommended eating patterns that are lower in saturated fatty acids, total fat, and cholesterol as a means of reducing their likelihood of disease. The special needs of women for nutrients such as calcium, iron, and zinc can be met within these eating patterns.

- **The elderly**. For most individuals 65 years of age and older, the recommended eating patterns that are lower in saturated fatty acids, total fat, and cholesterol, that help maintain desirable body weight, and that are nutritionally adequate, are appropriate. Special attention, possibly including nutrition guidance from a qualified health professional with special nutrition expertise, may be needed for some elderly people who have special nutritional needs or who are limited in their ability to procure, prepare, or consume food.

- **Cultural groups**. Foods and menus should accommodate cultural, regional, and ethnic preferences, while incorporating the recommended intakes of saturated fatty acid, total fat, and cholesterol.

- **Low-income groups**. Low-cost foods meeting the recommended eating patterns are available; individuals of lesser economic means can and should select these to improve their diets and share in better health.

- **People with special nutritional needs**. Health professionals should be attentive to individuals who have special nutritional needs, such as pregnant or lactating women, patients with food allergies, and many patients with diabetes mellitus, or chronic kidney, heart, or liver disease, who often need counseling from a health professional with special nutritional expertise.

E. Health Professionals

RECOMMENDATION E. 1: The panel recommends that health professionals advise patients and the public to attain the recommended eating patterns.

Physicians, nurses, registered dietitians, nutrition and health educators, pharmacists, and other health professionals have the opportunity to be important influences on patients and the public concerning the attainment of the panel's recommendations. Health professionals should both practice and advocate the recommended eating patterns. Initial and continuing nutrition education for health professionals should emphasize the panel's recommendations. Health professionals, as needed, should obtain assistance from others with special nutrition counseling expertise to facilitate achievement by patients and the public of the recommended eating patterns. In particular, health professionals should:

- Ensure that adult patients have their blood cholesterol measured accurately and that the meaning of the results is clearly explained in keeping with ATP guidelines;
- Encourage and counsel their patients, as members of the public, to follow eating patterns that are low in saturated fatty acids, total fat, and cholesterol but that are nutritionally adequate;
- Support the use of more effective communication approaches for populations such as low-income, low-education, and minority groups, encouraging them to adopt these eating patterns;
- Provide shopping and food preparation guidelines that include economical food alternatives that are lower in saturated fatty acids, total fat, and cholesterol and that incorporate cultural, ethnic, and personal food preferences;
- Develop simple dietary self-assessment and self-monitoring techniques to help individuals evaluate and monitor their own eating patterns;
- Work with industry, government, and voluntary groups to improve, expand, and simplify consumer-oriented nutrition information, advertising, and labeling;
- Encourage health departments, hospitals, and clinics to provide nutrition education and services consistent with the nutrient intakes and eating patterns recommended by this panel through efforts such as printed materials, videotapes, and nutrition information services;
- Encourage all medical and other health professional schools to incorporate educational components consonant with the eating patterns and principles recommended by the panel;
- Work with health care agencies such as the medical centers of the Department of Veterans Affairs, the military health care system, private and public hospitals, local neighborhood ambulatory health centers, and other health care delivery organizations, to help patients and staff adopt and follow the eating patterns recommended by the Population Panel;
- Identify individuals with special nutritional needs or eating problems who may benefit from assessment and intervention by a qualified health professional with expertise in nutrition counseling such as a registered dietitian; and
- Serve as role models for the public by adhering to the recommended eating patterns.

F. The Food Industry

What people eat is influenced by many factors. These include both individual factors and the nutritional environment of the Nation. Individual factors include the variety of cultural heritages, economic factors, the availability of food, the taste of food, and knowledge about food. The environment includes a broad array of influences on the food chain. Recognizing the influence of each of these factors on the food that Americans eat, the panel makes the following recommendations concerning the diverse elements in the U.S. food chain.

RECOMMENDATION F. 1: The panel recommends that food producers, manufacturers, and distributors increase the availability of good-tasting foods that are lower in saturated fatty acids, total fat, and cholesterol.

This can be accomplished through the following activities.

- Expand efforts to produce, manufacture, and market animal products lower in saturated fatty acids, total fat, and cholesterol with particular emphasis on leaner cuts of meat and lower fat dairy products;
- Continue efforts by the agriculture industry to produce, manufacture, and market processed plant products containing smaller amounts of saturated fatty acids, and larger amounts of complex carbohydrate and dietary fiber, including soluble fiber;
- Continue development of safe food preservation techniques suitable for products containing unsaturated fatty acids;
- Continue development of methods for mass preparation of food containing lower levels of saturated fatty acids, total fat, and cholesterol;
- Continue development of foods and menus that will help people attain the recommended intakes of saturated fatty acids, total fat, and cholesterol and that will ensure adequate nutrient intakes;
- Encourage food industry and agricultural commodity groups to adopt products, policies, and positions consistent with these recommendations while assuring both continued responsiveness to consumer desires and necessary profitability; and
- Provide professional education materials, and consumer brochures, cookbooks, and recipes, as well as other print and nonprint educational materials indicating ways of practicing the recommended eating patterns.

RECOMMENDATION F. 2: The panel recommends that the food industry participate actively in helping the public attain desirable eating patterns through labeling and advertising activities.

This can be accomplished through the following activities.

- Promote foods that are low in saturated fatty acids, total fat, and cholesterol, working with the advertising industry and the media to ensure that accurate messages reach large segments of the public;
- Provide comprehensible quantitative information on most food labels concerning saturated fatty acids, total fat, cholesterol, and calories to enable consumers to make informed choices;
- Avoid misleading the public through advertising or product labeling (e.g., refrain from promoting the "no cholesterol" claim for plant origin products when these products contain relatively large amounts of fat, especially saturated fatty acids, and avoid making health claims that are not supported by scientific evidence);
- Publicize the good taste and economy as well as the health-promoting characteristics of an eating pattern low in saturated fatty acids, total fat, and cholesterol; and
- Encourage hard-to-reach segments of the population such as low-income, low-education, low-literacy, and minority groups to choose food products that are low in saturated fatty acids, total fat, and cholesterol.

RECOMMENDATION F. 3: The panel recommends that food vendors and other food distribution sites participate actively in the national effort.

This can be accomplished through the following activities.

- Develop and disseminate point-of-purchase information in individual grocery stores, supermarket chains, restaurants, and cafeterias to identify foods low in saturated fatty acids, total fat, and cholesterol;
- Label, promote, and expand the selection of food choices that are lower in saturated fatty acids, total fat, and cholesterol in places providing food to large numbers of people such as institutional food services, restaurants, convenience or "fast food" outlets, schools, worksites, government agencies, hospitals, transportation services, catering services, and other feeding programs;
- Expand the availability and encourage the selection of foods that are lower in saturated fatty acids, total fat, and cholesterol in government-subsidized or -supervised food programs (e.g., school lunch programs); and
- Continue to develop ethnically and culturally appropriate food selections that are lower in saturated fatty acids, total fat, and cholesterol.

RECOMMENDATION F. 4: The panel recommends that the food industry, including food and animal scientists, food technologists, and nutritionists, continue to develop and modify foods to help the public meet the recommended eating patterns.

This can be accomplished through the following activities.

- Intensify research and development of food products that are lower in saturated fatty acids, total fat, and cholesterol;
- Continue development of economically feasible uses of food processing by-products—such as meat trimmings—containing saturated fatty acids, fats, and cholesterol, other than as human food; and
- Assure that as substitutes for food components such as fat are developed, there is clear evidence of safety for human consumption.

G Mass Media

RECOMMENDATION G. 1: The panel recommends that the mass media provide information on a lower saturated fatty acid, lower total fat, and lower cholesterol eating pattern.

Through their news, information, entertainment, and advertising policies and programming, the mass media have the ability to influence large numbers of people. As critical channels of communication to the public, the mass media are extremely important allies in the effort to reduce blood cholesterol levels throughout the population.

H. Government

RECOMMENDATION H. 1: The panel recommends that government facilitate attainment of healthful eating patterns by modifying policies and approaches.

Federal, state, and local governments are responsible for many programs and policies related to nutrition and to health. The following governmental activities will help promote cholesterol-lowering eating patterns.

- Increase collaboration among government agencies—e.g., the USDA, the Federal Trade Commission, the Federal Communications Commission, the U.S. Department of Veterans Affairs, and the DHHS including the Food and Drug Administration (FDA), the National Institutes of Health (NIH), and the Centers for

Disease Control—to provide consistent, coordinated nutrition statements and policies emphasizing low saturated fatty acid, low-fat, and low-cholesterol eating patterns;

- Help consumers make informed choices through expansion and standardization of food labeling requirements, especially through collaborative efforts of the FDA and USDA with the food industry, to include on most packaged foods easily comprehensible labels that clearly identify, among other nutritional characteristics, the content of saturated fatty acids, total fat, and cholesterol, as well as total calories;
- Develop, implement, and educate consumers concerning quantitative definitions for such terms as "lean," "low-fat," "low in saturated fatty acids," and "lite";
- Improve labeling of meat to help consumers select lean cuts;
- Increase state and federal government efforts to provide consistent nutrition education and food choice guidance for the public emphasizing the desirability of foods with low-saturated fatty acid, low total-fat and low-cholesterol content; and
- Revise food-related policies to stimulate production and distribution of foods low in saturated fatty acids, total fat, and cholesterol (e.g., the recent encouraging movement toward reduction of saturated fatty acid content of school lunch programs).

I. Educational Systems

RECOMMENDATION I. 1: The panel recommends that all public and private educational systems become active partners by disseminating information about the role of eating patterns in CHD prevention.

Attainment of lower blood cholesterol levels and reduced risk of CHD will be enhanced if educational programs at all levels—elementary through high school grades, vocational schools, colleges, universities, and medical schools—increase nutrition education. Accordingly, the panel recommends a focus on low saturated fatty acid, low-fat, and low-cholesterol eating patterns in the following nutrition education materials and activities:

- Curricula in health education, science, and home economics classes as appropriate for kindergarten through 12th grades;
- Curricula of culinary arts education programs emphasizing purchase, preparation, and presentation of foods and menus low in saturated fatty acids, total fat, and cholesterol;
- Curricula of university food science departments, including consideration of how advances in molecular biology, genetic, and production techniques can facilitate development of new food products with reduced saturated fatty acid, total fat, and cholesterol content;
- Curricula of college and university undergraduate programs, especially biological science, health, nutrition, and physical education; and
- Curricula of all pre- and postdoctoral physician and other health professional education programs (e.g., for nurses, dietitians, and pharmacists).

RECOMMENDATION I. 2: The panel recommends that existing nutrition education programs expand and be compatible with the recommended eating patterns, and that messages from major organizations concerning health-promoting eating patterns be consistent.

Many organizations already offer nutrition education programs to help Americans reduce cholesterol levels or meet other dietary goals. Examples are programs offered or supported by voluntary organizations (e.g., American Heart

Association, American Cancer Society) or by federal, state, or local government agencies. Education programs offered through the network of USDA's Extension Service can effectively communicate nutrition information to targeted audiences. Divergent messages can confuse the public; consistent, coherent information is needed.

J. Measurement of Blood Cholesterol

RECOMMENDATION J. 1: The panel recommends that public screening for blood cholesterol be undertaken only under conditions that ensure adherence to high quality standards.

Measurement of blood cholesterol serves to augment awareness of elevated blood cholesterol as a personal health problem. Recognizing the vital importance of cholesterol awareness, the NCEP has promoted a broadly based public education program—"Know Your Cholesterol Number"—to encourage all adult Americans to know their blood cholesterol level.

The ATP recommended that all American adults have their blood cholesterol measured at least once every 5 years. Cholesterol measurements should meet the accuracy and precision standards of the Laboratory Standardization Panel. The usual approach to detecting high blood cholesterol is through the physician's office. In addition, public screening provides the possibility of detecting large numbers of individuals with high blood cholesterol. However, the reliability of cholesterol measurements, the education of participants, and proper referral and followup in public screening programs all need special attention.

Only under specific conditions should general public screening for blood cholesterol be used to supplement screening in the health care setting. The NHLBI Workshop Regarding Public Screening for Measuring Blood Cholesterol[22] recommended the following criteria for public screening.

- Use recruitment approaches that attract all adult segments of the community and develop special approaches for harder-to-reach target groups. These include men, younger adults, low-income or low-education groups, and minorities;
- Evaluate the performance of each cholesterol analyzer before conducting a public cholesterol screening, and document ongoing internal and external quality control procedures, to ensure that cholesterol measurements are precise and accurate, and that they meet the standards of the Laboratory Standardization Panel of the NCEP;
- Ensure that public screening programs are managed by staff trained and supervised by appropriate health professionals and are supported by a qualified health institution and that the quality of all aspects of screening programs is evaluated;
- Provide cholesterol screening at a reasonable cost to the participants, with moderation of the cost for certain low-income group participants as necessary;
- Provide reliable verbal and printed educational information about cholesterol levels from knowledgeable staff, so that individuals understand the meaning and limitations of a single cholesterol measurement, receive information on dietary practices to lower cholesterol, and are given clear instructions with respect to their own medical followup;
- Recommend referrals on the basis of the NCEP guidelines shown in table 4, page 30; and
- Emphasize that screening is not a substitute for health care and cannot replace medical monitoring of blood cholesterol levels of individuals already under treatment.

Recommendations for screening children and adolescents and for managing younger people with elevated cholesterol levels will emerge later from the NCEP's Expert Panel on Blood Cholesterol Levels in Children and Adolescents.

Table 4

Guidelines for Referral of People Based on Their Blood Cholesterol Level

Blood Total Cholesterol Level	Recommended Action
Greater than or equal to 240 mg/dL (High)	Refer to physician for followup.*
Between 200 and 239 mg/dL (Borderline-High)	Refer to physician for followup* if history of coronary heart disease (CHD) or if two or more other CHD risk factors (excluding HDL-cholesterol) detected on interview (see table 2, page 9). If no reported history of CHD or less than two other risk factors, refer to physician within 1 year for repeat cholesterol measurement.
Less than 200 mg/dL (Desirable)	Recommend a repeat blood cholesterol followup in 5 years.

*Individuals should be seen by their physicians within 2 months.

Source: NCEP ATP, January 1988[1]

K. Research and Surveillance

RECOMMENDATION K. 1: The panel recommends that research and evaluation on the relationships between food and health continue and that the panel's recommendations be reconsidered in a timely manner as new scientific information becomes available.

The following specific activities should be undertaken:

- Continue efforts to clarify even further the role and the interactions of dietary components and nutrients, and blood lipids, atherosclerosis, and CHD;
- Improve analytical methods for food composition and continue development and application of the National Nutrient Databank of commodity and commercial products, including brand name information as appropriate to provide reliable information about nutrient composition of foods consumed by Americans;
- Collect and evaluate data, individual and societal, pertaining to dietary change along with evaluations of effects on CHD and other health status indicators. These data should include information on food production, processing, and consumption patterns and costs; population levels of blood cholesterol; and trends in cause-specific morbidity and mortality. Information concerning the efficacy of reaching all segments of the population should be

collected at the national, state, regional, and local levels. Many of these databases are ongoing through the work of government agencies—e.g., NHANES surveys; National Center for Health Statistics (NCHS) mortality statistics; FDA/NHLBI consumer and NHLBI health professional surveys; FDA total diet surveys; USDA nationwide food consumption surveys; state-based behavioral risk factor surveys—and should be continued or improved, while other data needs will require development of new monitoring systems;

- Expand research and development related to the reduction or alteration of fat content in foods of animal origin as recommended in the National Research Council report, *Designing Foods*;[11] and
- Continue to identify, develop, and evaluate effective nutrition education and communication methods.

V. Glossary

AHA	American Heart Association
ATP	Adult Treatment Panel
CHD	coronary heart disease
DHHS	United States Department of Health and Human Services
FDA	Food and Drug Administration
HDL	high density lipoprotein
LDL	low density lipoprotein
LSP	Laboratory Standardization Panel
MRFIT	Multiple Risk Factor Intervention Trial
MUFA	monounsaturated fatty acids
NCEP	National Cholesterol Education Program
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute
NIH	National Institutes of Health
NRC	National Research Council
PUFA	polyunsaturated fatty acids
RDA	recommended dietary allowance
SFA	saturated fatty acids
USDA	United States Department of Agriculture

VI. Bibliography

1. MRFIT Research Group, personal communication, 1989.

2. National Center for Health Statistics—National Heart, Lung, and Blood Institute Collaborative Lipid Group. Trends in serum cholesterol level among U.S. adults aged 20-74 years. Data from the National Health and Nutrition Examination Survey, 1960 to 1980. *Journal of the American Medical Association* 257:937-42, 1987.

3. National Cholesterol Education Program. *Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults*. Bethesda, MD: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Heart, Lung, and Blood Institute, NIH Pub. No. 88-2925, January 1988.

4. Truswell AS. The development of dietary guidelines. *Food Technology in Australia* 35:498-502, 1983.

5. National Research Council. *Diet and Health: Implications for Reducing Chronic Disease Risk*. Washington, DC: National Academy Press, 1989.

6. Gyárfás I, Stanley K. Diet and chronic diseases: A global perspective. *Acta Cardiologica* XLIV:487-89, 1989.

7. World Health Organization Study Group on Diet, Nutrition, and Prevention of Noncommunicable Diseases. Diet and chronic diseases: A global perspective (in press.)

8. Inter-Society Commission for Heart Disease Resources. Primary prevention of the atherosclerotic diseases. *Circulation* 42:A55, 1970.

9. Inter-Society Commission for Heart Disease Resources. Optimal resource for primary prevention of atherosclerotic diseases. *Circulation* 70:155A-96A, 1984.

10. American College of Cardiology. Eleventh Bethesda Conference: Prevention of coronary heart disease, September 27-28, 1980, Bethesda, MD. *American Journal of Cardiology* 47:713-76, 1981.

11. National Research Council, Committee on Technological Options to Improve the Nutritional Attributes of Animal Products, Board on Agriculture. *Designing Foods: Animal Products Options in the Marketplace*. Washington, DC: National Academy Press, 1988.

12. U.S. Department of Agriculture/Department of Health and Human Services. *Nutrition and Your Health: Dietary Guidelines for Americans*, 2nd ed. Washington, DC: U.S. Government Printing Office, HG-232, 1985.

13. National Cancer Institute. *Cancer Control Objectives for the Nation—1985-2000*. NCI Monographs, No. 2. Bethesda, MD: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, 1986.

14. Human Nutrition Information Service. *Nationwide Food Consumption Survey: Continuing Survey of Food Intakes by Individuals, Women 19-50 Years and Their Children 1-5 Years, 1 Day*. Hyattsville, MD: U.S. Department of Agriculture, CSFII Report No. 85-1, November 1985.

15. Human Nutrition Information Service. *Nationwide Food Consumption Survey: Continuing Survey of Food Intakes by Individuals, Men 19-50 Years, 1 Day*. Hyattsville, MD: U.S. Department of Agriculture, CSFII Report No. 85-3, 1985.

16. Human Nutrition Information Service. *Nationwide Food Consumption Survey: Continuing Survey of Food Intakes by Individuals, Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1985.* Hyattsville, MD: U.S. Department of Agriculture, CSFII Report No. 85-4, 1985.

17. Human Nutrition Information Service. *Nationwide Food Consumption Survey: Continuing Survey of Food Intakes by Individuals, Women 19-50 Years and Their Children 1-5 Years, 4 Days, 1986.* Hyattsville, MD: U.S. Department of Agriculture, CSFII Report No. 86-3, 1986.

18. Grundy SM, Barrett-Connor E, Rudel LL. Workshop on the impact of dietary cholesterol on plasma lipoproteins and atherogenesis. *Arteriosclerosis* 8:95-101, 1988.

19. Human Nutrition Information Service. *Dietary Guidelines and Your Diet: Preparing Foods and Planning Menus; Making Bag Lunches, Snacks and Desserts; Shopping for Food and Making Meals in Minutes; Eating Better When Eating Out.* Hyattsville, MD: U.S. Department of Agriculture, HG-232 #8-11, 1989.

20. Human Nutrition Information Service. *Dietary Guidelines and Your Diet.* Hyattsville, MD: U.S. Department of Agriculture, HG-232 #1-7, 1986.

21. Cronin FJ, Shaw SM, Krebs-Smith SM, et al. Developing a food guidance system to implement the dietary guidelines. *Journal of Nutrition Education* 19:282-302, 1987.

22. National Heart, Lung, and Blood Institute. Recommendations regarding public screening for measuring blood cholesterol: Summary of a National Heart, Lung, and Blood Institute workshop, October 1988. *Archives of Internal Medicine* 149:2650-54, 1989.

DISCRIMINATION PROHIBITED:
Under provisions of applicable public laws enacted by Congress since 1964, no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity (or, on the basis of sex, with respect to any education program or activity) receiving Federal financial assistance.
In addition, Executive Order 11141 prohibits discrimination on the basis of age by contractors and subcontractors in the performance of Federal contracts, and Executive Order 11246 states that no federally funded contractor may discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. Therefore, the National Heart, Lung, and Blood Institute must be operated in compliance with these laws and Executive Orders.